Space Interferometry Mission

The Space Interferometry Mission (SIM) spacecraft will be launched in June of 2005 into a nearly circular orbit around the Earth. A Delta H 7920 launch vehicle will boost the SIM spacecraft from the Vandenberg Air Force Base into Earth orbit. Over the next three months, the flight system will be calibrated and prepared for the science observation phase. During the science observation phase, data will be collected and returned from a precision optical interferometer on-board the spacecraft for five years and will enable fundamental new discoveries in both galactic and extra-galactic astronomy.

SIM will utilize a Sun-synchronous data collection orbit at a 900 km index altitude, a descending node orientation of 6:00 pm with respect to the fictitious mean Sun, and an orbit inclination of 92.034°. In this orbit, the SIM spacecraft will circle the Earth every 102,9 minutes. An observational scenario will be developed such that the nominal viewing axis of the interferometer is not within 90° of the Sun nor within 30° of the Earth.

SIM is comprised of three co-linear Michelson optical interferometers. Two of the interferometers observe bright guide stars and are used to determine the attitude changes of the interferometric baselines with a high degree of accuracy. The third interferometer is used to observe the objects of scientific interest. SIM will be designed to provide both narrow angle and wide angle astrometric measurements, synthesis imaging, and image nulling.

SIM will perform unparalleled wide-angle astrometry with an accuracy of at least 4 μas, roughly a factor of 250 over the current state of the art, and narrow-angle astrometry with an accuracy of 0.6-1 μas. This precision enables the measurement of distances to sufficiently bright objects in the galaxy by direct parallax with no more than 10% error and makes possible highly accurate proper motion measurements of objects. As a consequence, SIM will allow studies of the kinematics of both isolated stars and composite systems over a large fraction of our galaxy and of large-scale transverse motions out to 100 Mpc.

The interferometer system has three major sub-systems: starlight, metrology, and electronics/software. The starlight sub-system collects the stellar photons and acquires the starlight fringe patterns. Pointing and pathlength control loops are used to control the tilt and delay between the two arms of each interferometer in order to acquire the fringe signal. The metrology sub-system is used to calibrate each interferometer by monitoring changes in the three baselines and delay line positions. The electronics/software sub-system controls the operation of each interferometer and provides the control loops for the starlight sub-system and on-board processing for the metrology sub-system. Use of active optics makes the instrument insensitive to thermal deformations of the structure and metrology boom.

The S/C system consists of six sub-systems: structure, telecommunications, attitude control, power, control and data handling, and thermal. No propulsion system is required since the S/C is injected into a sufficiently accurate and stable orbit by the launch vehicle.

SIM will be NASA's first space-based science interferometer and will be the first of a series of future astrophysics missions. SIM will provide the technological foundation for these future missions.